

REMARKS/ARGUMENTS

Claims 1-6 and 9-34 are pending herein, with claims 3-5, 9, 15-23, 25, 26 and 28-33 withdrawn from consideration. Claims 1, 2, 6, 7, 10-14, 24, and 27 are under examination, with claim 1 being independent. By this Amendment, claim 1 has been amended to include *inter alia* the subject matter of claim 8, now canceled. New dependent claim 34 is added. No new matter has been added. In light of the amendments and remarks set forth below, Applicant respectfully submits that each of the pending claims is in immediate condition for allowance.

In the pending Office Action, the Examiner rejected claims 1, 2, 6, 7, 10, 11, 13, 14, 24 and 27 under 35 U.S.C. § 103(a) as obvious over WO 00/40886¹ (Baylot) in view of U.S. Patent No. 5,020,481 (Nelson) and U.S. Patent No. 6,213,157 (Thiebaud); claim 8, under 35 U.S.C. § 103(a) as obvious over Baylot in view of Nelson and Thiebaud and further in view of U.S. Patent No. 6,000,438 (Ohrn); and claim 12 under 35 U.S.C. § 103(a) as obvious over Baylot in view of Nelson and Thiebaud and further in view of U.S. Patent No. 6,703,127 (Davis). Applicants have carefully considered the Examiner's rejections and the reasons offered in support thereof and respectfully disagree with the conclusions reached by the Examiner. For the reasons set forth more fully below, it is submitted that the invention as claimed is patentably distinct from the art applied by the Examiner.

The present disclosure.

The following description of the invention is taken from the specification and is provided for the convenience of the Examiner. It is not intended to argue limitations not present in the claims or

¹ Baylot as applied by the Examiner is a WIPO publication of a French PCT application, which corresponds to United States Patent No. 6,978,825. Reference to specific portions of Baylot herein shall be made with reference to the corresponding U.S. patent, for ease of reference.

to argue for an interpretation of any claim term that is different from, or narrower than, the broadest reasonable interpretation of such term as may be accorded such term by one of ordinary skill in the art after a full and fair reading of the specification.

The invention is directed to a device for thermally insulating an undersea pipe. The device includes a thermally insulating covering contained in a leakproof, flexible, case. The case confines a phase-change material ("PCM") within a plurality of pre-fabricated walled containers disposed about the pipe. A main insulating material is disposed between the outer case and the phase change material, so that the containers holding the PCM are placed close to, but not in direct contact with, the pipe. In other words, according to the present invention, the insulating device comprises, from the inside to the outside, a rigid pipe, an insulating gel, a phase-change material confined within a flexible or semi-rigid container, the same insulating gel, and a flexible or semi-rigid outer case.

Confining the PCM in deformable flexible containers, as in the present invention, presents numerous advantages. It is much easier to put the PCM into place around the pipe because the containers are filled with the PCM separately and in advance. The PCM can be localized in the zone where it is most effective, i.e. essentially localized close to the pipe. The containers maintain the insulating PCM in a desired shape, which is important because the PCM is subject to migration. However, since the containers are flexible or semirigid, the phase-change material can be subject to changes in volume as a result of changing phases since the containers can deform. The containers make it possible to use insulating PCMs inside the case and also to use other insulating materials outside the case that would be chemically incompatible with the PCM, were they to come into contact with each other. The containers have sufficient flexibility to accept deformations, and in

particular to follow the deformations that result from the material changing volume when it changes phase. (Specification as filed at p. 13, ln. 25 — p. 14, ln. 16.).

The outer case is completely filled with a main insulating material 3₃, and the gaps between the containers 3₂ and the syntactic shells 3₄ are there to make it easier to fill completely all of the residual space inside the case 2. Since the outer case 2 is deformable, it can deform without significantly increasing its internal pressure compared with the pressure at the sea bottom. (Specification as filed at p. 37, ln. 33 *et seq.*).

Disclosure of Baylot.

Baylot teaches a device for insulating undersea pipes by use of a PCM 4 contained in a matrix 2. (Baylot at Abstract) Matrix 2 is in direct contact with pipes 1₁-1₂ (Baylot, Figs. 1 and 2), and is not a flexible container. Baylot does not disclose, or even hint at, the possibility that PCM 4 is not in direct contact with pipe 1.

Disclosure of Thiebaud.

Thiebaud discloses a space inside a carrier pipe 1 which is intentionally not entirely filled by the buoyancy module material or by the flow lines 2₁, 2₂, 3₁, and 3₂. This space is exposed to the hydrostatic pressure outside the carrier pipe 1. The space includes annular space 5 between the buoyancy module 4₁ and 4₂ and the pipe 1 and the axial voids 6₁ and 6₂ hollowed out from the buoyancy module material to accommodate the respective flow lines 2₁, 3₁, 2₂, and 3₂. The voids 6₁ and 6₂ communicate with the annular space 5 and remain at a pressure equal to the external hydrostatic pressure. (Thiebaud at col. 3, ll. 5-17).

Disclosure of Nelson and Ohrn.

Nelson discloses an insulating arrangement in which an insulating material is confined in containers made of “thick walled tubular shaped” elements (Nelson at col. 20, ln. 40) which are not likely to be flexible or otherwise deformable. This is an important distinction, because the PCM of the invention can be subject to changes in volume when changing phase. A rigid container, such as the one in Nelson having thick walls, will not accommodate the changes in volume which accompany use of a PCM.

Additionally, Nelson teaches the use of an insulating material which is in direct contact with the pipe (Nelson, pipe 297 in Fig. 39C and pipe 322 in Fig. 42C). This is consistent with the teachings of Baylot, discussed above. Likewise, Ohrn teaches insulating a pipe 12 with PCM 22 which is in direct contact with pipe 12 (Ohrn, Fig. 2).

The claims are allowable over the cited prior art.

Among the limitations of independent claim 1 not present in the cited combination are

a phase-change material confined in a plurality of pre-fabricated containers, each of the plural pre-fabricated containers being entirely filled with the phase-change material and each of the plural pre-fabricated containers having walls made of a flexible or semirigid material that is deformable to follow deformation of said phase-change material when it changes phases, and a main insulating material disposed between said outer case and said containers; and

said containers are disposed around and close to, but not in direct contact with, said pipe,

wherein said main insulating material surrounds said pipe and provides separation between said pipe and said plurality of containers in the gap between said containers and said pipe.

Baylot, which is the only reference that discloses utilizing a PCM as an insulating material never discloses nor suggests the confinement of such phase-change material within flexible or semi-rigid containers. Further, none of the cited references discloses main insulating material in the gap between the containers and the pipe, with the main insulating material surrounding the pipe.

The Examiner states "it would have been obvious to ... modify Baylot by providing a small space between the insulation shells and the inner pipe, as suggested by Thiebaud to allow for equalization of pressure within the pipe in a subsea environment." (Office Action at p. 3). If, indeed, the annular space 5 in Thiebaud is provided for pressure equalization, filling such space with the main insulating material as recited in claim 1 would not be obvious. In fact, filling such a space would eliminate any pressure equalization benefits that such space would provide.

Further, Nelson does not disclose nor suggest that the containers 270 containing a liquid or loose material insulation are flexible to follow the deformation of the material contained therein. Specifically, Nelson discloses:

Section 340 is hollow and semi-cylindrical and configured so as to be filed with insulation and then a hinged or inner cover member assembled thereto so as to create a generally semi-cylindrical tubular clam shell half for use in insulating around pipes, conduits, tanks and related members. In the event section 340 would need additional rigidity or stiffening due to either the material used for this shell portion or because of the length of section 340, it is envisioned that a stiffening rib 341 would be assembled (or integrally molded) every so many inches or feet along the length of section 340.

(Nelson at co. 23, ln. 44 *et seq.*). Nelson's material for the container 270 is relatively rigid and, if not rigid, the additional rigidity provided by the stiffening ribs 341 would prevent the container 270 from being deformed so as to follow deformation of a PCM contained therein.

Further, it is noted that in Ohrn, the PCM insulating material is not confined within flexible or semi-rigid containers, but, the PCM layer 22 is in direct contact with the rigid inner pipe 12. Neither Nelson nor Ohrn discloses or suggests using a gel insulating material intercalated between the flexible containers of PCM material and inner rigid pipe and a flexible outer case. Further, neither Nelson nor Ohrn disclose or suggest using a gel insulating material intercalated between the flexible containers of PCM material and outer covering as recited in new claim 34.

Accordingly, for at least the reasons above, claim 1 is allowable. Withdrawal of the rejection and early and favorable action is respectfully solicited.

Claims 2-6, 9-29, and 34 depend from, and contain all the limitations of claim 1. These dependent claims also recite additional limitations which, in combination with the limitations of claim 1, are neither disclosed nor suggested by the cited references and are also directed towards patentable subject matter. Thus, claims 2-6, 9-29, and 34 should also be allowed.

Claim 12 was rejected under 35 U.S.C. § 103(a) as obvious over Baylot in view of Nelson and Thiebaud and further in view of U.S. Patent No. 6,703,127 (Davis). Davis was not added to cure the deficiencies of the primary combination but to show additional limitations which, even if it were to show, do not cure the deficiencies discussed above. As such, Applicants respectfully submit that claim 12 is allowable over the cited combination.

Applicants have responded to all of the rejections and objections recited in the Office Action. Reconsideration and a Notice of Allowance for all of the pending claims are therefore

respectfully requested. If the Examiner believes an interview would be of assistance, the Examiner is encouraged to contact the undersigned at the number listed below.

It is believed that no fees or charges are required at this time in connection with the present application. However, if any fees or charges are required at this time, they may be charged to our Patent and Trademark Office Deposit Account No. 03-2412.

Respectfully submitted,
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Dated: July 12, 2010